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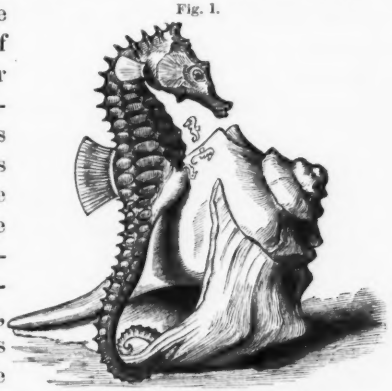
THE SEA-HORSE AND ITS YOUNG.

BY REV. SAMUEL LOCKWOOD.

"Sir," said an aged fisherman, "there is nothing on the Land that is not in the Sea!" The old waterman's terseness forestalled the philosophic dictum of the poet,—"Whether we live by the sea-side, or by the lakes and rivers, it concerns us to attend to the nature of fishes, since they are not phenomena confined to certain localities only, but forms and phases of the life in nature universally dispersed." Among these forms is a remarkable Order, called by systematists the Lophobranchs, which stand apart from the others by two well-defined, and very curious distinctions. They differ from other fishes in the peculiar structure of the gill arches, by

Fig. 1.



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which the gills are arranged in little tufts on each side of the head under the "cheek" bones or gill covers. Hence the name Lophobranch, which is derived from the Greek, signifying tuft-gilled. But, perhaps, more curious is that distinction drawn from their mode of reproduction; a trait so strange, as to suggest the seemingly abnormal habits of the Marsupials,—the Opossum and the Kangaroo,—although the eccentricity of the fish is far greater than that of the land marsupial; for, in the latter, it is the female whose pouch receives the immature young, and which are therein nourished to complete their development. The parental relation of the female Lophobranch, however, is restricted to the simple emission of the unimpregnated eggs. Beyond this, maternity she has none. The male is really, and literally, father and mother to the progeny; and so far as the reproductive instincts are concerned, it would seem that the female manifestation is summed up and exhausted in the one solitary and singular act of a formal consignment of the ova to the embryonal sack of the male.

Though the species of the Lophobranchs are quite numerous, they are all referable to three principal groups or families, of which the Flying Dragon (*Pegasus*), the Sea-horse (*Hippocampus*), and the Pipe-fish (*Syngnathus*) are types. The following observations were made upon the *Hippocampus hudsonius* De Kay, or the common Sea-horse of the Atlantic coast of the United States.

A sea-side residence favoring the design for the past ten years, I have let no opportunity slip of studying the habits of the Sea-horse, hoping to get at some of the necessarily interesting facts which must stand connected with its peculiar mode of reproduction. Owing to difficulties too tedious for detail, nothing like gratifying suc-

cess was attained until the autumn of 1866. Nearly a year had passed without obtaining a single living specimen, when a waterman brought me two full-grown ones, and to my great joy they proved to be "gravid" males. Alas! my oft-repeated experience returned; for, owing to the shock produced by the ordeal of acclimation, they began to involuntarily emit their young. None but a working naturalist can appreciate the anxiety I then suffered. The next day one of my Hippos died, having from debility first set free all its immature young, which were sufficiently developed to indicate plainly their family relation. My estimate was that they were twelve-day embryos. I now redoubled my efforts to invigorate and save the remaining adult, by solicitously watching every circumstance of temperature, æration, and light. In spite of all, the emission of the young went on, until instinct, prompted by increasing debility, led the parent to expel the rest by voluntary effort. *How* this was done was a great point gained. Except a few floating fronds of Ulva, other than the fish, there was no object in the water. And here the structure of the Sea-horse's tail should be borne in mind, so unlike that of any other fish, covered with an envelope, consisting of bony scales; four-sided, and suggesting a small square file; in faculty, prehensile, like that of some monkeys; and of considerable length. Bending this appendage upwards like an inverted crook, thus imparting to it muscular rigidity, the animal pressed it against the bottom of the embryonal pouch, which occupied the lower part of the abdomen, thus pushing its contents upward, and forcing them out of the opening on the top of the sack; the creature all this time sustaining its normal, erect position in the water. The extruded young immediately perished. Relieved of his charge,

my Hippo soon recovered strength, and became for several months a very interesting pet.

September 7. To-day fortune smiled and brought me another "gravid" male Hippocampus. This also, under the weakening effects of acclimation, began excluding the young, having emitted a full dozen. Circumstances favoring, and profiting by a varied experience, I was enabled to carry my new Hippo safely through the dreaded ordeal. Most anxiously was he watched day by day. To my astonishment no enlargement of the embryonal sack could be detected. I supposed that as the young increased in size, the distension of the pouch would go on equally. Again my apprehensions were aroused,—now I feared that the fœtuses were dead!

September 21. A red-letter day! To-day near noon I observed three young Sea-horses swimming about. They had just made their *debut*. Very minute creatures they were; but, to my great joy, nearly perfect. From that hour the *Pater-mater* kept busy setting his progeny adrift. At the bottom of the vessel was a broken Winkle-shell, put there for the attachment of the animal's tail, when fatigued by swimming, as the Sea-horse is very easily tired, and this, monkey-like, is its favorite mode of taking rest. The Winkle afforded real help in the labor of extruding the young, which is in no sense a parturient process, but on the contrary is entirely mechanical, and in the present case was effected in the following manner. With its abdomen turned towards the shell, its tail attached to the under part of it, the body erected to its full height, the animal, by a contractile exertion of the proper muscles, would draw itself downwards, and against the shell, thus rubbing the pouch upward, and in this simple, yet effective way, expelled

the fry at the opening on top of the sack (See Fig. 1). It was said above that the Sea-horse is soon wearied, with even moderate exertion; hence, probably, it was, that these repeated acts were each followed by a few minutes of rest. Indeed, the extrusion of its young lasted for nearly six hours, from three to six individuals being set free at a time.

The scene that followed was one of singular and lively interest. I was nervous with delight, and wished that every Naturalist could see it for himself. I am sure there is no student of nature but will excuse the enthusiasm which prompted me to write at once to a friend, that "he must not set the minister down as a horse-jockey, on being informed that he was now the proud possessor of the most numerous drove of colts ever owned by one man the whole wide world over." Using my best judgment,—for, owing to the mazy motion of this tiny throng, counting was out of the question,—I set the number down as not far from a thousand. Each measured from five to six lines in length. Very minute creatures, truly, when one considers how large a portion is taken up by the tail, which organ was of but little more than thread-like dimensions. We might suppose it would require a few days for the young Hippo to find out the remarkable monkey-like endowment of its tail. Not so. Only look at what my own eyes beheld many a time, when a "stampede" of these little colts was going on, although they were but one day old. There come two little Hippos, each swimming in a direction at right angles to that of the other. Just at the point of passing, one, lasso-like, whips his caudal extremity round that of his fellow, who, of course, in like manner, returns the caudal compliment, which, to speak technically, acts as a "double lock." Of

course both pull, and, by a natural law, the force is exerted in exactly opposite directions, and the right angle is resolved into a straight line. It is but poor head-way they make, nor does it mend the matter much, that a third little fellow comes giddily on, and, switching his tail, takes a hitch at that precise point in space where the other two met. Now a triple force is exerted, and the effect is, with two straight lines to project three obtuse angles. And so the three toil on, obtusely laboring *in statu quo*. But a droller sight is that of yonder juvenile Lophobranch, who seems to be of somewhat belligerent proclivities, as he is leading by the nose a weaker member of his own species, having with his caudal extremity noosed him on the snout. These funny antics, though oft repeated, are of short duration, as the parties soon have to rest, from sheer fatigue.

On the fifth of October the last of my little Hippos died.

In the matter of fœtal sustenance, I find a remarkable marsupial analogy in the Hippocampus. The pouch of the Kangaroo and the Opossum contains teats, with which, by true lactation, the young are nourished until fully formed. Nor is the embryonal sack of the Sea-horse a mere receptacle, or nest, for the hatching of the eggs,—the fish does, in and by the pouch, supply nourishment to the growing young. The mass of fry on the day of its extrusion is certainly in bulk several times greater than that of the original egg-mass. We know that the bear during hibernation lives upon the fat acquired the previous season. During a journey that requires abstinence from food, the well-conditioned camel will subsist on the absorption of its fattened hump. The tail of the frog, which has just completed its last metamorphosis, does not

pass off by atrophy, but is really a wise provision for the creature's support by absorption, during the few days which constitute the most critical period of its life.

This fact I have demonstrated elsewhere by observations from the spawn to maturity. But in these and similar cases, the animal is simply nourished by some superabundance in itself. Ruling out lactation, and the placental phenomena of gestation, is there any instance in which, as a normal fact, the young feeds upon the parent? This fact, seemingly so anomalous, I assert for the Hippocampus, although its physiology I may not be able to explain. The male Sea-horse not only hatches the eggs in the embryonal pouch, but also feeds the young by allowing them to absorb a portion of himself. This is done during the embryo's consumption of the placental yolk, and also, especially and more rapidly, after that source of food is all exhausted. Of course, upon receiving the ova the pouch might be supposed to be considerably distended. This distension is really very trifling. And during development the enlarging of the sack might be expected; but it is inappreciable. At the time of receiving the spawn, the wall of the pouch is not less than three lines thick, and well stored internally with fat. At the time of expulsion of the developed fry, the same sack is not half a line thick, and hangs flaccid on the animal, a mere thin membrane. In due time it becomes again thick, firm, and fat as before, and in such state has been mistaken by me for a gravid condition. This interesting fact of a true marsupial nourishment, and of so unique a character, although suspected, was not accepted, until established by dissection, and observation of a male that had gone through the course described. Moreover, I believe in part may be thus explained the impulse to that forcible

eviction of the immature young, which has been already described. The debility caused by the consumption of the parent, together with the weakening of acclimation, seems to have impelled to the act.

But with the exclusion of the young, the marsupial likeness stops in the Sea-horse, though the young Pipe-fishes are said to reënter the pouch on finding themselves in danger. It is my belief that with the Sea-horse the termination of development is the end of their solicitude for the young.

As to the moral relation of the sexes in this apparently abnormal creature, I must regard it, on the instinctive side, as but little superior to the relation of a pistillate to a staminate plant. The emission of the ova by the one is a simpler matter, all the facts considered, than the seeding of the other. Certainly the love emotion, if any, must be very simple, scarcely more than the poetic figment of the loves of the flowers. Is not the fertilization of the spawn performed by the male after its reception into the embryonal pouch? Besides, that which is usually normal in the female, is in this instance wholly wanting, namely, affection for, and even the knowledge of the young; for she never sees them. Whereas the male, even though pressed by hunger, will not molest his offspring,—a remarkable fact, when we reflect that generally fishes have no scruples against devouring any fry, even their own. This trait of the male Sea-horse is found in the male Stickleback. The former is not very demonstrative, nor can he be, owing to his organization; but the latter is highly so, even to vindictiveness, as I have seen him severely punish the female in his anxiety for the safety of the spawn. There are other undetermined, although interesting facts, connected with this question of sexual relation. What is

the numerical proportion of the sexes? Does the male incubate the ova of more than one female at a time?

Allusion has been made to the Stickleback. It was to the two-spined species (*Gasterosteus biaculeatus*). This species breeds in the months of March, April, and May. Much depends upon the season. Generally the whole matter is over by the last week in April. My experience, from the examination of many gravid specimens, indicates that the Sea-horse breeds in August and September.

Fig. 2, though drawn without the proper aid from the microscope, is intended to exhibit some of the fœtal phenomena, and represents the premature young, which I have supposed to be twelve days old from the commencement of incubation. Fig. 3 is one of the same magnified, and presents the following particulars worthy of note. First, the tail is round, instead of quadrangular; second, the dorsal fin is set farther back than in the adult; third, the pectoral fins are also farther back on the nape than in the adult (though not to the same extent, yet facts two and three I have seen in fœtuses much older); fourth, the extreme shortness and great width of the muzzle.

Fig. 2.

Fig. 3.

The Sea-horse, when taken fresh from his native home, though almost laughably grotesque, is a very pretty creature. Its general color is ashen gray; at first glance, an exceedingly sober suit. But if examined more closely, it will be found thickly studded with tiny spangles of metallic silver. Add to this its rich armature of daintily carved plates, like a coat of mail, its body always pertly erect, and, bent forward, it looks like the steed of a knight-errant in quest of adventure; and those pretty,

golden, yet queer little eyes, chameleon-like, independent of each other, intently gaze two ways at once. Then as to that dorsal fin, in oddity and beauty it has no compeer among its ichthyic rivals, so tastily fringed with a neat border of delicate yellow, precisely like the yellow tipping of the tail of the Cedar-bird (*Ampelis cedrorum*). In truth, this dorsal fin is cruelly libelled in every engraving we have ever seen. In nature it is an exquisite fan, in form, size, and ornament, worthy the hand of Queen Mab. Thus our Sea-horse, though anomalous in form and habit, has beauty united with its strange features, and grace with its eccentricity. In fine, as we look at his equine appearance, and think of his monkey faculty, and his opossum traits, and that queer blending of innocent oddity with patriarchal dignity, we have to accept the old fisherman's proverb,—"There is nothing on the Land that is not in the Sea."

THE RECENT BIRD TRACKS OF THE BASIN OF MINAS.

BY C. FRED. HARTT, A. M.

(Concluded from p. 176.)

Sir Charles Lyell, who visited Nova Scotia in 1842, first called attention to the recent bird tracks of the Basin of Minas, and Dr. J. W. Dawson, the distinguished Nova Scotian geologist has treated of them in his interesting little volume, "Acadian Geology."

The mud flats of the Minas Basin are made up to a very large extent, some entirely, of these thin layers of mud, deposited by the successive tides. The deposition of the layers does not of course go on equally everywhere, but

only in localities sheltered from the action of too strong currents. In these accumulations there is thrown down a layer for each tide, those deposited by the night tides being thicker than those formed during the day. During a long interval of repose thin layers only are deposited, while just after a heavy storm that stirs up the whole bay, the deposits are much increased in thickness. Nor are these accumulations confined to the shoals laid bare at low tide; but they extend over the bottom of the Basin, though they must naturally be much thicker near the shores whence the materials were originally derived. Dr. Dawson says that "these layers are thicker on the edge of the flats than near the shore; and hence these flats, as well as the marshes, are usually higher near the channels, than at the inner edge. From the same cause, the more rapid deposition of the coarse sediment, the lower side of the layer is arenaceous, and sometimes dotted with films of mica, while the upper side is fine and shining, and when dry has a shining and polished surface. The falling tide has little effect on their deposits, and hence the growth of these flats, until they reach such a height that they can be overflowed only by the highest tides."

It is to the zone embraced between high and low-water marks that the subaerial tracks, such as we have described, are confined, the only markings made on the submerged layers being entirely those of aquatic animals, tracks of crabs and other crustaceans, trails of shell-fish and marine worms, or scratches made by fishes; but markings of this kind may extend over the whole part reached by the tide, while low tide is the lowest limit at which tracks of land animals can be found.

The *Tringæ* and other waders visit the shores of the Basin only in the summer, so that through the whole

series of layers formed during the winter, none of these tracks occur. In the winter months the shores are encumbered with masses of ice and snow, and are quite deserted. The floating ice scores and ploughs up the banks in exposed localities, and the regularity of the deposits must be very much broken during that time. The ice forming on the shores and floated off at high tide carries away an immense amount of shingle and loose material, often large boulders, and drops them over the bottom of the whole Basin, and one sees blocks of trap from Blomidon lying on the flats about Horton and Cornwallis. This annual drift phenomena must leave its record in the boulders and coarse material distributed through the finer material laid down during the winter, while the summer layers would be entirely free from them.

It will be readily seen that the mud deposits can only accumulate in the quieter parts of the bay, and that as we go from these to points where the tidal currents increase in velocity, we shall pass from mud deposits to those of sand and gravel, while the shores will vary in the character of their beaches according to the kind of rock exposed at the water's edge. Thus under the red sandstone cliffs of Cornwallis and Blomidon, we have sand beaches in exposed localities, muddy shores where the waves are shut out, while trap-shingle is strewn along the shores of Blomidon.

The Strait of Minas is very narrow, and one can readily imagine that the immense mass of water which twice a day is poured into the Basin, and twice a day drained off again, must cause tremendous currents setting through the strait, and that wherever these are felt, only the coarser deposits are to be looked for.

These mud banks, these accumulations of sand, gravel,

and shingle really form a great diary of the life of the Basin, and we see that the history that is daily written upon them is readily to be translated. Well, we have got our boots and pants well covered with mud, we have gathered a handful of specimens of bird tracks and a pocket full of muddy shells, and we have learned something of how Nature writes down in her great Stone Book the history of the world. Before us are the last few pages of the manuscript, and we have watched in the tracks left by the running bird, the pen gliding over the page. Aye, we too have added our lines to the history. Will the coming tide respect them and seal them up forever, or will it blot them out as unworthy of a place on the page? Behind us and around us in the hills are volumes written long ago by the same ever-recording pen; but Nature makes *palimpsests*, as did the scribes of the middle ages, and writes over and over on the same page. See, yonder at the mouth of the Avon is a range of cliffs called Horton Bluff, formed of layers of the lower coal measures. They form a chapter in the geological history of the Province, and are written all over with quaint old records of ancient forests of coal-plants, and of antique mailed and spine-armed ganoid fish; but the scribe, wanting material on which to record the history of the present, is destroying the old manuscript, spreading out its leaves anew, re-prepared for the more modern characters in which the chapter of to-day is being written. After all our scribe is but a chronicler, like old Froissart. Geologists are the historians that work over this material. They are not satisfied with leaving the detached facts recorded, but ask the *why* and the *wherefore* of their occurrence and their relations one to another. One who merely translates the detached facts of the geological record is no more

entitled to be called a geologist, than a translator of Froissart can claim to be a historian.

If you were to examine the beds of Horton Bluff, you would occasionally find one on whose surface are markings, such as we observe nowadays being made on the sea-shore; some of the layers are ripple marked evidently by the waves, or by shallow agitated water. All these beds were deposited under water in the shape of sand and mud. The late Dr. Theodore Harding, of Windsor, discovered on the surface of one of these layers, the tracks of a kind of reptile. The animal had evidently walked about over the rock when it was soft, and its footprints were preserved just as the recent impressions of birds' feet are now being preserved on the shores near the bluffs. Tracks of worms are sometimes found on the same beds, and at Parrsboro' we have found what appear to be the tracks of some large crustacean.

Tracks of animals have been formed, of course, ever since the world has been inhabited, and these are preserved in rocks of all ages wherever the necessary conditions obtained, from the Lower Silurian "Lingula flags"* of St. John, New Brunswick, to the deposits now forming.

Many years ago, Dr. Deane found on the surface of slabs of sandstone, quarried in the Connecticut valley, the tracks of a three-toed animal which he took to be a turkey; but Professor Hitchcock, of Amherst, having examined them, showed that they were not made by that fowl, but by some bird-like animal long since extinct. Attention being called to the subject, it was found that these and other footprints were scattered through a great thickness of these sandstone beds, and Professor Hitchcock, before he died, described over one hundred species of animals from

*The writer pointed out the primordial age of these beds in 1865. Mr. E. Billings believes them to be the exact equivalent of the "Lingula flags" of England.

their tracks found in the Connecticut River sandstone. There cannot be the slightest doubt that during the Triassic period the valley of the Connecticut, from New Haven to a point about one hundred and twenty miles north of that city, and with an average width of about twenty miles, formed an estuary, to which the sea had imperfect access, and that the sandstones and shales which now fill it, were therein deposited, under circumstances exceedingly like those under which the mud deposits are now accumulating in the northern estuaries of the Avon and Cornwallis, though there was there a slow submergence going on which gave an opportunity for the distribution of the tracks through hundreds of feet of beds, a thing which would otherwise have been impossible. In this estuary were extensive mud-flats and sand-banks covered by high tide, and left bare when the tide was out, and these were the resort of great numbers of animals whose footprints are alone preserved. The majority of these animals were reptiles, but others were probably birds. Huge fellows were some of them, making tracks about two feet in length. Yet, though these footprints are very abundantly handed down to us, the rocks themselves hold scarcely a vestige of animal remains. Besides a few fish, a shell or two, and an insect, only a few broken bones have been discovered thus far, and these last enable us to form only a suspicion as to the character of the animals to which they belonged. It would be very unlikely that the remains of land animals, which only frequented the shores between the tides, should be found in the deposits there forming, and we have already remarked how rare it is to find a dead bird on the Horton shores.

Some of the shale-beds of the Connecticut valley resemble very closely, both in color, texture, and composition,

the dried mud-layers of the Basin of Minas. I have before me now a slab from one of the finer-grained beds of the Connecticut valley. Except that it is more solid, it could not easily be distinguished from a well-baked specimen of the Minas mud. Its surface is marked with beautifully preserved rain-prints, as clearly impressed as one sees them after a mid-day "sprinkle" on the Horton mud-flats, and to make the resemblance more complete, there is on one side an incipient crack, like the gash of a knife where the mass in shrinking had begun to tear apart, but had not separated sufficiently to form a complete crack.

From these studies we must see that the phenomena going on around us must be the Rosetta stone, which shall furnish us with the key for the deciphering of the hieroglyphics of the Stone Book, and that we shall understand the results of the forces which acted in the past, in proportion as we correctly understand their action in the present.

Let us now see what was going on "down east" when the Connecticut valley was an estuary. Nova Scotia had at that time very much the same appearance as at present, but the land was more sunken, and the range of hills that skirts the Bay of Fundy, the North Mountains, did not then exist. The bay washed the northern slope of the South Mountains, and the Basin of Minas formed the head of the bay. The shores of the Minas Strait were then on the north, very nearly as at present; but Capes d'Or and Sharpe, as well as Partridge Island, and the Two or Five Islands, now noted for their beautiful zeolitic minerals, had not yet a being; neither had Isle Haute lifted its lone head above the waters of the bay. On the south the shore ran along the range of hills, the continuation of the South Mountains, from Kentville by Wolfville, and the

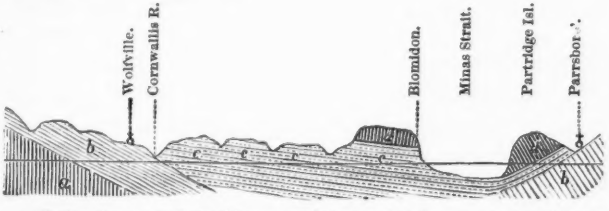
Horton Mountains to Truro. There was then no strait at all. The Basin opened broadly into the Bay of Fundy. Cobequid Bay was much wider than at present, and penetrated eastward beyond Truro. One of the Acadian provinces, Prince Edward Island, was wanting.

Within the whole bay thick beds of red sand were deposited, and similar strata were at the same time accumulating in the Gulf of St. Lawrence, off the northern coast of Nova Scotia, and especially over the area now occupied by Prince Edward Island. These beds now form a coarse friable red sandstone which is almost entirely barren of fossils, for it had afforded only a few reptilian remains in Prince Edward Island. Acadia must at that time have been peopled with animals, and covered with vegetation; but the conditions for the preservation of the remains of either were very unfavorable. The bay was then open to the full sweep of the tide, which may at that time have acted with even much greater force in the region of the Basin of Minas than at present, because the tidal wave, not being obliged to pass, as at present, through the narrow Strait of Minas, would have had an opportunity of exercising its full force, rising higher and higher as it rushed up the ever-narrowing head of the bay, but it may have been that at that time the isthmus which unites the peninsula of Nova Scotia with the main land was submerged, in which case the extraordinary tidal phenomena of the Bay of Fundy could not have resulted. The sandstone beds show, in their oblique lamination, the action of strong and shifting currents. There was not the same opportunity presented for the preservation of such footprints as may have been left on these sands, as existed in the quiet estuary of the Connecticut, or the present Basin of Minas. At intervals during the deposit

of the Connecticut River beds, there were volcanic disturbances, attended by the formation of dykes, and the spreading out over the beds of thick masses of lava. The New-Red Sandstone period was attended in Nova Scotia by similar phenomena. Just after the formation of the sandstone beds in the Basin of Minas and Bay of Fundy, submarine volcanic action broke out along the line of the present North Mountains, and immense quantities of melted matter were thrown up from beneath, and spread over the New-Red Sandstone strata, either in liquid, molten streams, or a volcanic ash. This ancient lava is called *trap*. The volcanic disturbance went on for some time, until these beds had acquired a great thickness. Similar eruptions took place at the same time at the Two, Five, and Partridge Islands, Capes d'Or and Sharpe, and at the Isle Haute. It is very probable that all these now isolated trap masses may have been at that time continuous.

The land was then elevated so as to bring all their beds in the Basin of Minas, and along the shores of the Bay of Fundy above water, and as the red sandstone beds had a slight dip to the northward along the southern coast, the volcanic beds had a like dip towards and under the bay. The trap beds were very thin inland, but became thicker towards the shore. Running water began its work on the southern edge of the trap deposit, along the present line of the valley between the North and South Mountains, and with the assistance of glacial action and the sea, which afterward flowed through it, excavated that depression. To the north, the waves, beating along the whole bay coast for centuries, cut away the trap-beds, so that we have now only a narrow strip left, the North Mountains from Blomidon to Briar Island. At the time of the elevation of the New-Red Sandstone beds, the Basin of

Minas, as well as a large portion of the Bay of Fundy, was occupied with them; but they have since been largely removed, except where overlaid by trap deposits, or otherwise protected, and only small remnants are now left fringing the shores of Nova Scotia and New Brunswick. Prince Edward Island made its appearance with the rise of the land, and it must at first have been of much greater extent than at present, perhaps even having been united to Nova Scotia.



a, Silurian strata. *b*, Carboniferous sandstone and shales. *c, c, c, c, c,* Triassic red sandstone. *d*, Trap overlaying red sandstone.

The reptiles and birds of the New-Red Sandstone period have passed away, and the earth is peopled by a new creation. In that period the world had reached that stage in its development when it was fitted for the rule of the brute force of giant reptiles. To-day *mind* rules. God's other creations signed their mark on the pages of geological history.

NOTE.—The above diagram is an ideal vertical section across the country from Wolfville to Parrsboro', intended to show the relative position of the beds of rock of which it is composed. The hills south of Wolfville consist of beds of sandstone and shale, *b*, belonging to the lower part of the Carboniferous formation. These beds are inclined to the north, and they rest on the upturned edges of beds of slate, *a*, of Lower Silurian age. Carboniferous beds, *b*, appear at Parrsboro', but they are much newer than those near Wolfville. In the trough-shaped depression in these Carboniferous strata, the ancient Basin of Minas, lie the thick beds of the New-Red Sandstone, *c, c, c, c, c*, which, except where they are protected by the overlying masses of trap, *d, d*, at Blomidon and Partridge Island, are worn away into low hills, or cut through by the river or the water of the Strait. The horizontal line represents the sea-level. This section is based on one by Dr. Dawson, in his "Acadian Geology," with additions by the writer.

Professors Agassiz and Clark, and Mr. A. Agassiz, have detailed very fully the anatomy and classification of our native species.

The Jelly-fishes of our coast are represented by numerous globular and disk-like animals of a gelatinous texture, more or less transparent, having certain appendages consisting either of longitudinal bands of vibrating fringes, as in one order; or, as in another order, having appendages surrounding the mouth, and others, thread-like, hanging from the margin of the disk. The parts most conspicuous within the body are the ovaries, or egg-sacks, the stomach, and certain tubes running from the stomach to the periphery of the body.

These animals are apparently radiated in their structure; at all events, it is difficult in certain groups to distinguish a right and left side, and for this reason they are called Radiated animals, and form one of the three classes of the branch RADIATA.

The Jelly-fishes of our coast are common in our harbors and inlets, where the water is fresh and pure from the ocean. A very ready and convenient way to collect them is to moor your boat on the shady side of a wharf where the reflected rays of the sun are avoided, and, as the tide sweeps gently past, to dip them as they are borne along by the current. Some little practice is necessary to discern the smaller kinds, for many species are very minute, and other species, though of good size, are nevertheless hard to distinguish on account of their extreme transparency. They may be dipped from the water with a tin dipper, though a wide-mouthed glass jar is better for this purpose. As they are secured, they may be poured into a wooden pail for assortment and examination at home; or, better, a large glass jar, carried on purpose

to hold them, may be filled at once, as too frequent changes destroy them.

Some species are very hardy, and may be kept alive for weeks, while others live only a few hours, gradually diminishing in size till they appear to melt away in the water.

Among the more common forms met with on our coast is the *Pleurobrachia* (Plate 8, Fig. 8). Words fail in describing the beauty and singularity of this Jelly-fish. Conceive a globular body the size of a walnut or larger, but perfectly transparent, having eight bands of rapidly vibrating fringes surrounding the body, running from one pole to the other like the ridges on a walnut, and two thread-like appendages, festooned with hundreds of shorter threads, trailing out behind the body like the tail of a comet, and you have a general idea of this Jelly-fish.

The zones of vibrating fringes act like so many little oars, and impel the body through the water. At times, only the fringes on one side are in motion, and then the body rotates in the water like a vital globe. Anon, the different zones alternate in action, and the body describes a spiral course in the water. The most beautiful prismatic hues are exhibited when these fringes are in motion, and these brilliant changing colors often lead to their detection in the water. The long thread-like appendages, already mentioned, are the most wonderful portion of the structure of this Jelly-fish. They are lined with hundreds of smaller threads which start at right angles from the main threads, and are all of the extremest tenuity. The distance these appendages can be projected from the body, the instantaneous manner in which they are drawn within the body, and the perfect control the animal manifests in their movements seems incredible,

until the movements have been actually witnessed. When contracted, these appendages occupy a space of exceeding minuteness, and when projected from the body seem to run out as a cable runs from a ship. We have sought in vain for any definite solution of the function of these threads, and are compelled to offer one derived from our own observations. Beside the locomotive power derived from the longitudinal zones of fringes, the body will be seen to oscillate to and fro, this motion being produced by the alternate contraction and relaxation of these threads, the resistance offered to the water by the sudden contraction of the expanded threads being sufficient to oscillate the body. The Jelly-fish in question, unlike most members of the class, swim with the mouth upward, and the appendages start from the pole opposite the mouth; and since the mouth is unprovided with any organs whereby to grasp food, the mouth has the power of sweeping back and forth in the water by the oscillations of the body, affording greater chances of coming in contact with their food. It has the power of seizing little shrimp-like animals, and a singular sight it is to see this Jelly-fish, with its repast perfectly visible within its transparent body.

There are two other forms of Jelly-fishes not uncommon in our waters, which have the zones of locomotive fringes, but have no trailing appendages, as in the species just described. One of these forms is called Bolina, and is somewhat larger than Pleurobrachia, being pear-shaped, and the larger end divided into two lobes which surround the mouth. These lobes have the power of expanding and contracting, and the contour of the animal is materially altered by their movements. They may sometimes be seen gaping wide, disclosing the mouth, and ready to

entrap its food, and again so contracted that the mouth is quite hidden.

Another form called *Idyia* is long and cylindrical like a tube rounded and closed at one end, the other abrupt and open; the open end constitutes the mouth. In fact, it is hardly more than a locomotive stomach. This Jelly-fish has more consistency than those heretofore described, and is quite opake. At certain seasons of the year they are pinkish in color. An individual of this species, when confined with Pleurobrachia, soon manifests its carnivorous propensities by attacking, and often swallowing the Pleurobrachia whole. It does not appear daunted if its victim proves larger than itself, but slowly, patiently engulfs its victim; and a curious sight it is to see the Idyia directly after this feat is performed, presenting the appearance of a tight skin drawn around the innermost Jelly-fish, though in a short time its food is digested, and the Idyia resumes its normal shape, and not in the least augmented in size. It probably requires a dozen or more of such game for an ordinary lunch. This statement will not be wondered at, if the experiment is tried of drying a specimen of Pleurobrachia on a white card, and finding nothing left but a few crystals of salt. The vitality of these Jelly-fishes is remarkable: they can be cut in several pieces, and yet each piece will remain alive for a long time in the water; and one naturalist, after having cut an Idyia in half longitudinally, observed one half to enfold, and digest another Jelly-fish.

The three forms thus far described are common representatives of an order of Jelly-fishes called *Ctenophoræ*, or Comb-bearers, the fringes or paddles having been compared by some writers to the teeth of a comb. These fringes form a distinguishing trait of the order. The

members of this order are reproduced directly from eggs.

We will now consider another order of Jelly-fishes called *Discophoræ*, or disk-like Jelly-fishes, since the form of many species present a disk-like appearance. Members of this order are very conspicuous in the water, owing to their large size, their opacity, and the distinctness of their egg-pouches. They have no zones of locomotive fringes, but hanging below the disk and surrounding the mouth are numerous appendages, and surrounding the border of the disk is seen a delicate fringe of threads interrupted at regular intervals by little dots called eyes. These Jelly-fishes swim in the water by successive expansions and contractions of the disk, making a motion something like the motion made by the partial closing and opening of an umbrella. This motion is very leisurely performed, and the animal appears drifted by the currents and eddies with but little power to direct its course.

Our most common species, the *Aurelia* (Plate 8, fig. 5), occurs abundantly in our bays, sometimes in vast multitudes. When full-grown they measure from twelve to fifteen inches in diameter.

Another form, called *Cyanea*, often attains an immense size. Mr. A. Agassiz gives an account of one that measured seven feet across the disk, and whose appendages stretched out to the length of one hundred and twelve feet; their average size, however, is about one-third the dimensions just given.

The nettling sensation produced by certain Jelly-fishes, when brought in contact with the naked body, has long excited the attention of naturalists. The Cyanea is one of the most formidable in this respect, and Prof. Edward Forbes describes an English species as "the terror of ten-

der-skinned bathers. With its broad, tawny, festooned, and scalloped disk, often a full foot or more across, it flaps its way through the yielding waters, and drags after it a long train of riband-like arms, and seemingly interminable tails, marking its course when the body is far away from us. Once tangled in its trailing 'hair,' the unfortunate, who has recklessly ventured across the graceful monster's path, too soon writhes in prickly torture. Every struggle but binds the poisonous threads more firmly round his body, and then there is no escape; for, when the winder of the fatal net finds his course impeded by the terrified human wrestling in its coils, he, seeking no combat with the mightier biped, casts loose his envenomed arms, and swims away. The amputated weapons, severed from their parent body, vent vengeance on the cause of their destruction, and sting as fiercely as if their original proprietor itself gave the word of attack." Peculiar oval cells, each containing a little filament capable of protrusion, have been supposed to be the seat of this nettling sensation. These are called urticating cells, and the whole class of Jelly-fishes are called *Acalephs*, or Sea-nettles, from this peculiar property. These stinging cells cover the surface of the body and appendages, though, strange enough, there are many species possessing these cells that produce no stinging sensation whatever.

The strangest feature in the history of certain Jelly-fishes belonging to the order Discophoræ, as the Aurelia, for instance, is their wonderful mode of reproduction. It would require too long a time to detail the successive steps made before the whole truth was known regarding the development of these Jelly-fishes. How the successive stages were described by different zoölogists as entirely distinct animals, until at last it was proved that

they all represented the different stages of growth of one animal. The Aurelia, for example, gives origin to little locomotive eggs; these, swimming in shoals, finally effect lodgments on the rocks, one end becoming attached, and the other throwing out little tentacles as in Fig. 1, on Plate 8. In this condition they resemble miniature Polyps. Gradually they increase in length, and little transverse seams, or constrictions, appear on the sides of the body, these constrictions deepening, and their edges becoming scalloped. (See Plate 8, fig. 2.) Finally, the seams have deepened to such an extent that their appearance have been compared to a pile of saucers, and at last they become separated one after the other, each turning upside down, and swimming off free Jelly-fishes. In this stage they are called Ephyra, and are entirely unlike their parent in appearance. By the fall they will have attained their adult form, and a diameter of twelve or more inches.

Figs. 3, 4, on the Plate, represents Ephyras in different stages of growth, a short time after separating from the stalk. In spring time the water is alive with them.

By far the greater number of our smaller Jelly-fishes belong to another order called *Hydroids*, and pass through phases of growth equally as strange as those above recounted. The limits of our paper will allow only a few words on this group. On the rocks at low water, and on floating weed, little moss-like tufts will be found in abundance. This plant-like growth, when examined under a lens, will be seen active with life. The ends of the little twigs and offshoots appear as little bell-shaped cups, with tentacles studding the free ends like the plates of a flower; these are the fixed individuals, and are the purveyors of the community. In the spring time little capsules will be noticed on the twigs, within which are

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MORSE, ON THE JELLY FISHES.

to be seen minute globular bodies, to be finally set free by the rupture of the capsule, as free swimming Jelly-fishes. (See Plate 8, fig. 12: *a*, fixed individual; *b*, capsule containing young Jelly-fishes.) Others bud directly from the twig and drop off singly, as in *Coryne*. (Fig. 7, buds forming from Hydroid stalk; Fig. 6, adult Coryne.) These are found by thousands in spring time. Not only do these free Jelly-fishes bud from fixed communities, but in one species young ones bud from the Jelly-fish itself, as in *Lizzia* (Fig. 10), and certain others where the young bud from the stomach. All these Hydroid Jelly-fishes produce eggs, which again give rise to plant-like communities. At another time we hope to devote a chapter to the structure of Jelly-fishes, and illustrate more fully the character of the Hydroids, of which we have scarcely touched in this paper.

EXPLANATION OF PLATE 8.

Fig. 1. Early condition of *Aurelia*, — after AGASSIZ.
Fig. 2. Older condition of same, showing individuals about to separate, — after AGASSIZ.
Fig. 3. *Aurelia*, a short time after freeing itself, — original.
Fig. 4. Advanced stage of above, — original.
Fig. 5. *Aurelia*, in adult condition, — after AGASSIZ.
Fig. 6. *Coryne mirabilis* Ag., — original.
Fig. 7. Hydroid community of *Coryne* magnified, showing Jelly-fish buds about to separate, — after CLARK.
Fig. 8. *Pleurobrachia*, — after A. AGASSIZ.
Fig. 9. *Tima formosa* Ag., — original.
Fig. 10. *Lizzia grata* Ag., showing young ones budding from stomach, — original.
Fig. 11. Hydroid community of *Eucope diaphana* Ag., — after A. AGASSIZ.
Fig. 12. Showing one twig of *Eucope* with fixed individual A, and reproductive capsule B, containing a number of young Jelly-fishes, — after A. AGASSIZ.
Fig. 13. *Eucope*, in adult condition, magnified, — original.

AGENCY OF INSECTS IN FERTILIZING PLANTS.

BY W. J. BEAL.

Mr. Charles Darwin and other botanists have proved beyond a doubt, that some flowers, in which the pollen may easily gain access to the stigma of the same flower, are sterile unless fertilized by pollen borne from other flowers, while many are much more productive by a cross fertilization.

For information concerning the peculiar manner in which fertilization is effected in the Balsam, Wood-sorrel, Violets, Dicentra or Dielytra, Corydalis, Mitchella or Partridge-berry, Oldenlandia or Houstonia, Primrose, Barberry, Lysimachia or Loosestrife, Orchids, Dutchman's Pipe, and others; consult the observations recorded by Mr. J. T. Rothrock in the second number of the Naturalist, Mr. Darwin's work on the "Fertilization of Orchids," and seven articles by Dr. A. Gray in the "American Agriculturist," beginning in May, 1866.

With the fact that insects are necessary to fertilize some plants, and the theory that all are improved by crossing, let us see how this is accomplished in plants which may not seem to require the aid of the wind or insects. Plants are very rarely found in which the pollen may not, occasionally at least, get to the stigma of another flower of the same, or an allied species. Then if the pollen is "prepotent" or most effective on stigmas when thus transferred, a cross is very sure to result, even though much pollen comes in contact with the stigma of the same flower. Dr. Gray, acquainted with these facts, and familiar with the structure of the Iris, saw that insects must be needed for the fertilization of this plant also, and without seeing the bees upon them, shrewdly pointed out the manner in which

they must carry the pollen from one flower to another. We verified his theory by observations made two years ago, and found it to be true in the essential particulars.

Without giving a scientific description of the flower, it is enough for our present purpose to say, that the parts consist of three curved tubes, each just about large enough to admit a common honey-bee, being a trifle larger than a cell in her comb.

There is a showy crest, or attractive platform, projecting at the outer end of each tube upon which the bee first alights. When going into the flower for the first time during the day, she is free from pollen. She brushes against a lid which hangs from above, not unlike an old-fashioned swinging door of a cat-hole, as sometimes seen about barns or corn-cribs. When farther in beyond the lid, she comes against the anther, which only discharges pollen on the side next to the bee's back. After getting what nectar she can at the lower end of the tube, she backs out again, pushing the trap-door in the opposite direction. The outside of this door is the only part of the stigma upon which the pollen will produce any effect, so upon visiting the first tube no pollen adheres to the sensitive side of the stigma, although the bee leaves the place with her back well powdered. Calling at another tube, she dives in as before, this time dusting the outside of the lid with pollen which was brought from the tube first visited.

In the early part of June, I examined the common Blue Flag (*Iris versicolor* Linn.) at different times during the day, and always succeeded in seeing the bees at work while their heads and backs contained an abundance of pollen. In wilted flowers, and in some that were fresh, I saw bees occasionally get in and out at the side of the

tube, without touching the stigma at all. Sometimes they went in the tube as first described, and then slipped out at the side instead of backing out. Several went on top of the flower and tried to find other ways to get at the sweets below, but in every instance they failed, and soon left that position.

At the Botanical Garden, Cambridge, Mass., I noticed bees on several foreign species of Iris, in some of which, as *Iris pseudocarus* of Southern Europe, the tube is more nearly perfect, so that it is impossible for them to find a side entrance or egress.

The corolla of *Andromeda floribunda* Pursh, is nearly urn-shaped, hanging with the open end or entrance down. The ten long anthers open at the apex by two round holes, and each anther is supplied with two horizontal or reflexed awns on the outside next the corolla. The stigma is just at the narrow mouth of the corolla. Bees in abundance visit the flowers, thrusting their long tongue or proboscis against the awns or horns of the anther, as they reach in for nectar which is secreted farther on. By hitting the awns the anthers are disturbed, and the holes brought close against some part of the bee's proboscis, which is well sprinkled over with pollen, as well as the other mouth parts hanging below the flower. Bees were examined, and found to have the parts mentioned covered with the four-grained pollen which is peculiar to a few plants.

I cannot see how pollen alights on the stigmas of this plant, for in falling out in the natural way it must pass by to the ground. But the insect puts the material in place every time as effectually as a mason can stick mortar on the ceiling of a room. The Blueberry (*Vaccinium*) is similar in structure to the *Andromeda*, except that the

awns are wanting. Probably most flowers which droop or hang down are fertilized by insects. For otherwise, how can the pollen find the tip of a stigma, when the style is suspended?

The mode of fertilization in the American Laurel (*Kalmia*) has already been well described in the NATURALIST, but I may be excused for adding my testimony concerning this beautiful and interesting plant.

When the anthers are liberated from the pockets in the corolla, the stamens suddenly straighten and throw jets of pollen often for a foot or more, "acting," as Professor Gray used to say, "like a boy's pea-shooter."

Many times when the dew was on, I have seen the common honey-bee and other *Hymenoptera* about these flowers. When the bee alights on a flower, the style comes up between the legs where they join the body, or sometimes farther back against the abdomen.

In this position they turn around, as though they were balanced on a pivot, generally inserting the tongue outside of the filament, and, while doing this, pull the stamens with their legs towards the centre of the flower, releasing them and frequently receiving the shots of pollen on their own body. A single visit from an insect is sufficient to release all the anthers. By noon it was a difficult matter to find a flower which had not been visited in this way. Insects seem to be absolutely necessary for the perfect fertilization of *Kalmia angustifolia* and *K. latifolia*, for I tied small nets over some flower-clusters (*corymbs*), and found that when the bees were kept away, the flowers withered and fell off, most of the anthers still remaining in the pockets, and the filaments so decayed that their elasticity was entirely gone. The very few an-

thers liberated were probably brought out by the shaking of the bushes by the wind.

Considerable pollen was found stuck on the corollas by the nectar, which was uncommonly abundant, as no insects of much size were allowed to remove it. The wind might have carried some of this pollen to other flowers, or it might have dripped from those above to flowers below in drops of water (there were two showers during these experiments); but I infer this was not the case in the examples mentioned, because the flowers, especially the stigmas, remained fresh much longer than those which were left exposed to the visits of insects.

The flowers of several Honeysuckles, of the Mustard Family (*Cruciferæ*), of the Bladder-nut (*Staphylea trifolia* L.) were noticed, and in each case the conclusion reached was, that the chances are better for cross fertilization than otherwise.

The long cylindrical, bell-shaped corollas of the Purple Foxglove (*Digitalis purpurea*) are much visited by bees. The flowers are mostly obliquely suspended, and in all thus situated, the stamens and style are close to the upper side of the corolla. The insects alight at the opening of the corolla, on the side opposite the stamens. This is generally the lower side as the flowers hang, then reaching above, they catch hold of the style and stamens, and crawl in with the back down, brushing the whole length of the underside of the body, first against the stigma, and, farther on, against the anthers.

They seem unable to get into the flower without catching hold of the stamens, and it is often with considerable difficulty that they enter at all, for they are obliged to hold on to the edge with the hind legs until they can catch the stamens with their fore legs.

In the Evening Primrose (*Oenothera glauca* Michx., *Oe. Missouriensis* and *linearis* Michx.), the stigmas project beyond the anthers, and the flowers vary from an erect to a horizontal position. There are four large stigmas for each style, spreading in the form of a Greek cross.

The pollen, slightly held together by delicate threads, is collected in the morning by great numbers of small wasps, about two-thirds the size of honey-bees. I have often watched them while coming down on, or just over, the stigmas, leaving pollen as they went in, and after collecting what they could, fly out at the side without touching the stigma. On one of these plants, at two different times, a wasp was eagerly trying to pick up the pollen which had been left on the stigmas; the more they tried to collect, the more they scattered pollen about on the glutinous surface, until, as if discouraged or disgusted, they rapidly cleaned their legs of all the tangled mass, and flew away, leaving that cluster of flowers entirely.

In the flowers of the Pea, False Indigo, Yellow-wood (*Cladastris*), Red-bud or Judas-tree, Red and White Clover, Locust, and others of this large and important family (*Leguminosæ*), the anthers surround the stigma, and are closely covered by the corolla. This certainly looks like a very clear case for self-fertilization, but I doubt not the reverse is very often the case. Many of the flowers, as the Pea and Locust, have one petal much larger than the rest, called the standard or banner. Opposite this is another part composed of two petals sometimes united, termed the keel. On this keel bees uniformly alight, and crowd the head down next to the banner-petal. To enable them to do this, they kick the keel and side petals (wings) with their hind legs, and push them back so that the anthers and stigmas

come out from their concealment and meet the underside of the insect where pollen may be left or received. Why the style should be so uniformly curved upward, and all should be brought against the abdomen of insects, I cannot well conceive, unless it be of some use to the plant.

Lupine, another species in this family, has a remarkably long keel which makes a close sheath for the inside parts. On the style, just below the extremity, is a circle of long stiff bristles. As the keel is pushed down, only the stigma, with the bristles below, appears outside, and this pushes out a mass of pollen which generally hits some part of the insect. When left, the flower resumes its former position again.

For about six times pollen can be pushed out in this way, when the supply becomes exhausted. Insects begin on the lowest flowers, and so go up the spike to others which are higher and younger. No experiments have been made on Lupine to show whether it will produce more seeds when visited by insects than when protected.

ICE-MARKS AND ANCIENT GLACIERS IN THE WHITE MOUNTAINS.

BY A. S. PACKARD, JR., M. D.

During a visit last autumn to the White Mountains, we found ice-marks in the valleys of the Saco, Ellis, and Androscoggin Rivers. These grooves, and other signs of ice action, give the clearest evidence, that, during the Glacial Period, the White Mountains were covered by a central *mer-de-glace*, which discharged local glaciers into the principal valleys radiating from the central peaks.

Like the glaciers of the Alps, of the mountains of

Norway, of the Himalaya Mountains, and the mountains of New Zealand, the Andes, and the polar regions at the present day, these rivers of ice flowed down the valleys, like a plastic mass of frozen and refrozen snow and ice. We learn from the writings of geologists that in former times the Alpine glaciers, which now cling to the mountain peaks far up the valleys, descended during a period of great cold, when the Polar Bear, Reindeer, and other arctic animals were spread over Southern Europe, and extended far out upon the broad plains of Italy and Germany. Such must have been the scene in New England during the time of intense cold, known as the Glacial Period. But before theorizing, let us present the facts which seem to us new, and to confirm the opinions that have been before expressed by some of our geologists, that the principal valleys of the White Mountains have been filled with these rivers of ice. Our observations only relate to the eastern part of the mountains.

Let us first explain what is meant by ice-marks or glacial scratches, *striæ*, grooves, and moraines. The rocks and ledges in all the Alpine valleys are grooved and fluted by nearly parallel marks made by gravel and pebbles frozen into the bottom and sides of the slowly-moving mass of ice. The glacier thus grinds down, polishes, and scratches the rocks over which it moves. So steady and uniform is the motion of these immense bodies of ice, that the marks preserve a remarkably uniform course over the uneven surface of the valley. Sometimes a huge ledge projects into the valley. Around this the glacier sweeps, and the marks are curved at this point. Where the glacier debouches on to a broad plain, the ice-marks tend to radiate outwards, fan-like, from the mouth of the valley.

Moraines are formed of the debris or loose refuse matter accumulated either upon the surface, or crowded beneath the ice. The material derived from the latter source forms masses of clay, sand, and rounded stones, the latter of which are often found to be striated on one or more of the sides, like the surface of the solid rock beneath. On the top of the glacier rest long rows or trains of more angular blocks which have fallen from the cliffs above. These windrows of stones are called "lateral moraines," because they are found on each side of the glacier. When such a glacier melts away, a great semicircular heap or hillock of stones and dirt forms what is called a "terminal moraine." We would naturally expect to find the finer, clayey portions with rounded stones, grooved and scratched pebbles, and boulders at the bottom of the rude mass, while the more angular stones would remain upon the top. From the melting of the ice arise rivers whose turbid and swollen waters rush out from beneath the end of the glacier, and further aid in rounding the stones. Such torrential streams are the sources of the Aar, a branch of the Rhine, of the Rhone, and of other rivers which spring out from under the glaciers of the Alps and of Norway.

Our route to the mountains lay up the valley of the Ossipee River, in which Ossipee Lake, Six Mile Pond, and numerous other ponds lie. Looking from the village of Ossipee up the broad valley at the head of which rises the majestic Chicorua, and beholding on all sides lateral moraines thrown up in hillocks of partially stratified gravel and pebbles, and the beautiful glacial lakes embosomed in the gently swelling hills of this delightful valley, it was not difficult to imagine that old Chicorua, in former times, shook off from its icy dome streams of ice

which crowded far up, and even overflowed the sides of this valley, and when all had melted away, left as witnesses of the floods these placid lakes. These sheets of water, however, are not scattered at random over the face of New England. In this valley and the neighboring parts of Maine, they are arranged in a general north-west and south-east course, following that of the rivers. This direction is probably due to the fact that the valleys cut across the general north-east and south-west course of our mountain ranges, which compose the Appalachian chain.

We had no time to search for glacial scratches in the Ossipee valley, but cannot doubt that on examination they will be found pointing towards Mount Chicorua, where, according to Dr. C. T. Jackson,* they follow the general north-west course of this valley.

Riding up the Conway valley, with Kearsarge on our right, and the Mote Mountains on our left, up through Bartlett to Jackson, we observe moraines innumerable rising high up the sides of the valley, and covered with boulders, revealed more distinctly in all the cleared lands. Above these moraines rise rounded and embossed rocks, while the evenly terraced valley, over which the road passes, shows that at a former period (though long after the close of the glacial epoch) the river, then a series of broad lakes, rearranged and resorted the confused materials composing the mounds left by the melting glacier, into finely, evenly stratified fresh-water deposits, which now form the arable land of the plains, over which are scattered the picturesque villages and hamlets so familiar to the White Mountain tourist.

Ice-marks were first noticed at Jackson, on Thorn

* Report on the Geology of New Hampshire.

Mountain, a peak lying just south of Tin Mountain, and estimated by Prof. Guyot to be 2,500 feet high. Here the grooves are well marked, and point directly towards Mount Washington, their course being north 25° west. Even portions of a quartz vein which appears upon the surface is smoothly polished and finely striated. On removing the soil from the surface of the rock a part of the way up the mountain, and also directly upon the summit, these ice-marks could be easily discerned, all running in the same north-west and south-east direction. On Mount Kearsarge, three miles distant, which bears south 25° east from Thorn Mountain, Dr. Jackson states, in the Geology of New Hampshire, that part way up the mountain the drift-marks run north 35° west,—thus pursuing the general north-west and south-east course the valley here assumes. In hastily ascending this mountain on the north side from Jackson, we were not fortunate enough to discover any grooves in the rocks. Half way up the side, however, we found a boulder of a peculiar mica slate, containing large crystals of staurotide, or cross-stone, which must have been borne down on the back of the glacier from Mount Washington, as thick beds of this rock occur near the limit of trees, a little over four thousand feet up that mountain. Similar boulders occurred on some of the hills below.

On an adjoining hill near Goodrich's Falls, are very distinct ice-marks. Here we found a huge angular boulder of many tons weight, which had been apparently detached from the parent rock beneath, and moved a few rods to the south-east; for to the north-west are polished surfaces and grooves which had evidently been made by this large, slowly-moving mass of rock when frozen into the bottom of a glacier. The

surface of the reddish sienite had here been polished smooth as porcelain, as seen in little patches which had survived the centuries of weathering by frosts and snows, which has effaced most of the slighter traces of glacial action in our mountain regions. Here the marks pointed north 30° east. There were also strange marks in the rocks, called *lunoid furrows*, which are crescent-shaped depressions in the rock, with the concavity looking towards the north. The origin of these lunoid furrows have been thus explained. It is known that the glacier is in constant motion, advancing a few inches in summer, and then contracting in winter. Now imagine a stone frozen into the ice, and thus acting as a gouge. Pushed onward and then withdrawn by the powerful hand of the ice-king, it soon wears this peculiar shaped hole, then turns over out of the rut, and catches again in some inequality of the rock, and makes another lunoid furrow, or perhaps a series of four or five, often very regular in form, though the distance between them may vary.

Crossing over the range of mountains north of Mount Kearsarge into Stowe, Maine, we descend into the charming valley of the Cold River. This is a branch of the Saco, and, though now comparatively unknown, it must in future attract many travellers. We pause at the entrance of Evans' Notch, a mountain pass of great interest, and far surpassing Pinkham Notch in grandeur, reminding us rather of the White Mountain Notch. The gate of the pass is guarded on the west by Mount Royce, on the east by Speckled Mountain, whose nine spurs radiate into the towns of Stowe, Albany, and Stoneham. On the broad, flattened, glaciated summit of Speckled Mountain ice-marks abound, pursuing a course north 15°

east, following the course of the valley at this point, and pointing towards a higher peak situated a little to the northward.

In one place a beautiful beryl, in fine crystals of which the coarse granite abounds, has been sliced off by the abrading agent, and polished even with the surface of the feldspar matrix. There are broad surfaces of rock planed down by ice, both on the north-western and north-eastern slopes, showing that the ice must have slid down in both directions from the reservoir of snow which rested on the water-shed between the two valleys. Here, also, occur numerous lunoid furrows, pointing in the same general direction as the straight fine grooves. In the fields, at the bottom of the mountain, are several parallel trains of boulders, formerly lateral moraines, which lie ten or fifteen rods apart. We were informed that these windrows of boulders stop the plough, and it is only possible to turn the sod in the intervals between them, which are entirely free from boulders.

On Mount Baldface, which lies about three miles west of Speckled Mountain, and is composed of a pale fine sienite, with an unusually perfect rift, enabling it to be split into long thin slabs for building purposes, the glacial marks assume quite a different direction, running north 10° to 15° west. On the north-east face, perhaps five hundred feet below the summit, may be seen striæ and lunoid furrows in abundance, running over a smoothly glaciated spur, on which the striæ run north 10° west. Here the lunoids were quite abundant. Some were very large, measuring from one to three feet in diameter.

On the summit of the mountain rest several angular boulders of a peculiar porphyritic sienite, containing

curious oblong crystals of albitic feldspar. Our guide to their source—the trusty ice-grooves—point to Peaked Mountain, a peak lying perhaps half an hour's walk in a direction north 10° west. Under their guidance, and by occasionally following the paths made by bears through the stunted growth of spruce, we find the parent rock from which they had been torn, on the summit of Peaked Mountain, which is composed of this peculiar porphyry.

Passing through Evans' Notch into the valley of the Androscoggin, in the town of Gilead, we find marks on a ledge near the river, which follow a general north-west and south-east direction. This is the general course of the Androscoggin River at this place. Following this river to its mouth, where it empties near the sea-shore into the Kennebec River, the traces of glaciers observed at Bethel, Lewiston, and Brunswick show that a stream of ice once filled the valley throughout its whole length, from the mountains to the sea.

There was also a Peabody River glacier, which joined the Androscoggin glacier, as we may call it, at the junction of those two rivers near the Alpine House, at Gorham, N. H. A geological friend has detected on the north-east side of Mount Washington, on the carriage road, glacial grooves which point down the Peabody valley.

Thus we see the traces of five distinct ancient glaciers, filling as many river valleys, descending from the higher peaks of the White Mountains. In rounding off the tops of the mountains, scooping out the valleys, and levelling with their moraines the deep depressions in the surface of the earth, they were important agents in preparing the way for the advent of man, who should till the soil they

have borne down from the mountains and spread out in fertile plains.

Such are the lessons to be learned of drifted boulders, ice-marks, and moraines. Now looking back through the past, perhaps even hundreds of thousands of years, when an ice-dome capped these mountains, then probably rising much higher above the sea, and sending a glacier down each broad valley into the ocean, where their huge icy cliffs were laved by the waters of a frozen sea, we have to imagine ourself as if on the present coast of Greenland or Spitzbergen, and, looking inland from some mountain peak upon the coast, behold a vast sea of ice with jagged peaks rising up through the broad expanse, cleaving and throwing aside the slowly, imperceptibly moving currents of this inland sea of ice. Near the sea, partly warmed perhaps by the remote influence of the Gulf Stream, whose powers upon the coast of New England were greatly lessened during this period of intense arctic cold, were sunny valleys, carpeted with moss and sprinkled sparingly with lovely arctic flowers,—whose descendants still linger upon the summit of Mount Washington,—half-hidden beneath the snows, or clinging to the cliffs as if shrinking from the icy embrace of the glacier. Here the Reindeer and the Bison* met in herds, the arctic Foxes barked, and the arctic Hare nibbled the short summer's growth; while upon the drifting ice-cakes the Polar Bear sat watching for some stray seal, and the Mammoth, found fossil over the northern part of both hemispheres,

*The teeth of the Walrus and the Bison were discovered by Sir Charles Lyell in the clay-beds at Gardiner, Maine. These are still preserved in a private collection. The association in the glacial clays of the remains of the Bison with those of the Walrus, and the mingling of other arctic animals and plants with those now confined to British North America and New England, show that the climate, during the glacial period, was a little warmer than that of Southern Greenland at present. Though New England was covered with land ice, the climate of the Middle and Southern States, so far as indicated by fossils, did not differ greatly from what it is at present. Even while the Walrus and other arctic animals inhabited New England, the coral reefs of Florida were forming.

stalked over the plains. The Gare Fowl, or Penguin of the north (*Alca impennis*), probably reared its young, fattening them on the Caplin, which has been found fossil in our clay-beds; and the smaller Auks, the Gannet, the Puffin, and Eider Duck filled air and water with their hosts. Through the waves, schools of Narwhales may have disported and waged war with that Bull-dog of the northern seas, the Killer; while the Walrus and Greenland Seal thrust their half-dog, half-human face above the waves, and with angry bark, crowded and jostled each other off the smooth-backed skiers skirting the coast.

Did man gaze upon this scene? Did the forefathers of the Mound Builders or of the ancient Copper Miners of the Great Lakes ply these waters in their kayaks, and build their winter huts of snow amid these arctic scenes?

REVIEWS.

AN INQUIRY INTO THE ZOÖLOGICAL RELATIONS OF THE FIRST DISCOVERED TRACES OF FOSSIL NEUROPTEROUS INSECTS IN NORTH AMERICA; WITH REMARKS ON THE DIFFERENCE OF STRUCTURE IN THE WINGS OF LIVING NEUROPTERA. By *S. H. Scudder*. From the Memoirs of the Boston Society of Natural History. Vol. I. pp. 20, 4to. 1867. With a plate.

The study of the fossil remains of insects is attended with great difficulty. Indeed less is known, perhaps, of the Insect Fauna of former geological periods, than of most other classes of animals, with the exception of the worms and jelly-fishes (*acalephs*). From the fragments of wings, legs, and other hard parts of the insect crust, the fossil entomologist has to reconstruct the insect form of a by-gone period, by comparing these few fragments with their allies of the present day, just as Cuvier restored the quadrupeds of the Paris Basin, delineating their often rude, embryonic forms, from hints afforded simply by pieces of bone and disjointed parts of the skeletons, in some

cases, however, quite complete, discovered by the quarrymen of Montmartre.

The descriptions here given are of the remains of two insects found in the Coal Formation of Morris, Illinois, in company with various coal-plants and amphipod crustaceans, which latter are related to our little beach fleas. These insects were described and figured by Prof. J. D. Dana, in the "American Journal of Science and Arts," in 1864.

Each of the two insects is supposed by the author to form the type of a new family of the Neuroptera, both of which are described and compared with the other families. For such comparisons the author finds the neuration of the wings indispensable as a guide in tracing their affinities, and in limiting the different groups of the Neuroptera generally, of which the Dragon Fly, Forceps-tail, and Ephemera are examples. These two extinct families afford instances of a "synthetic type," a term applied to those animals which combine the characters of other groups, and which are added to their more essential points of differences. An example of the synthetic or comprehensive type is the Garpike, which retains the more essential characters of the fishes, while mimicking the scaly reptiles.

The plates contain partial restorations, one of the right upper wing of *Hemeristia occidentalis*, an insect allied remotely to the Golden-eyed, lace-winged fly, so common in our fields in summer, and the other (*Miamia Bronsoni*) still more distantly, to the gigantic Corydalus, found not uncommonly flying lazily and feebly at twilight in summer.

On the Parallelism between the different stages of Life in the Individual, and those in the entire Group of the Molluscous Order Tetrabranchiata. By *Alpheus Hyatt*. From the Memoirs of the Boston Society of Natural History. Vol. I. Part 2. 1867. pp. 16, 4to.

In this paper, the author makes a comparison between the old age, or period of decline, and the adult forms of allied species of animals, represented at present by the Nautilus and Argonaut. During extreme old age the shell, so to speak, falls into its "second childhood," as stated, though in a more scientific way, by the French naturalist D'Orbigny. This idea is, in the present article, still farther extended to include the collective life of this order of the class of Cephalopods, during the geological periods in which the order came into existence, culminated, and then declined and went out in forms both reminding us of the embryos of the Nautilus, etc., as well as of the earliest generic forms of the order. Thus the different stages of the life of the individual Nautilus or Ammonite accord with the collective life of the entire order.—A. S. P.

AMERICAN EDUCATIONAL MONTHLY. — *Devoted to Popular Instruction and Literature.* June, 1867. J. W. Schermerhorn & Co., New York. $1,50 per annum.

This lively and independent monthly does good service in the cause of education. Every number contains an article on Natural History, besides a special department containing gleanings in Science and the Arts. The present number contains valuable hints on the importance of the study of Natural History in Schools.

NATURAL HISTORY MISCELLANY.

BOTANY.

ROTTENNESS OF FRUITS. — The experiments of M. Devaine, recorded in the "Comptes Rendus," Aug. 20, 1866, prove that the rottenness of fruits is the result of the attacks of fungi, the different varieties in the form of the decay being produced by generic differences in the attacking fungi by the spores of which the fruit has been inoculated. Thus the rottenness determined by a *Mucor* or a *Penicillium* differs in density and color as well as in rapidity of development, and all the other Mucedineæ produce a rottenness so characteristic, that the name of the fungus which produced the mischief may be at once determined; for example, a *Helminthosporium* which attacks the carrot, produces a black putridity; a *Selenosporium?* Corda, which M. Devaine observed upon the cucumber, and which he propagated on this fruit, gives a beautiful red color to the flesh of the cucumber, whilst the rottenness of the same fruit, resulting from the invasion of a Mucor or a Penicillium, has no particular coloration. — *Quarterly Journal of Science.*

ZOÖLOGY.

THE RED-LEGGED GRASSHOPPER. — This terrible pest has been for several years immensely destructive in the far West, especially in Kansas, as we learn from a correspondent, who states that it "covered the country last August and September, destroying all the late crops, fall wheat, etc., and deposited its eggs all over the country. Now the farmers are in a quandary, and some are in despair, not sowing or planting, believing that it would be labor spent in vain, while others run the risk." It used to swarm at certain times in the Eastern States. Harris enumerates its visitations in New England in the last century, when it devoured every green thing, so that "days of

fasting and prayer were appointed" on account of the threatened calamity.

How shall the ravages of this well-known grasshopper be stayed? We doubt not that when the West is more thickly settled, and the eggs and young of the grasshopper exposed to the attacks of domestic animals, it will be less abundant.

The habits of this species are not well known, except that they appear in mid-summer in the winged state. The wingless larvæ appear in June, and, as Harris recommends, hay crops should be mown early, before they fly in swarms. The last of summer they couple, and probably lay their eggs in holes in the earth, which are hatched in the spring; at least such are the habits of the common Carolina Locust. As Harris suggests, this insect can only be kept under by concerted action on the part of farmers. "In the south of France the people make a business, at certain seasons of the year (probably in the autumn and late in the spring), of collecting locusts and their eggs, the latter being turned out of the ground in little masses, cemented and covered with a sort of gum, in which they are enveloped by the insects." Various forms of drag-nets can be invented for collecting them in large numbers, and run, if necessary, through a field by horse-power. The inventive genius of our farmers will easily suggest methods of gathering these insects by the bushel, when they can be thrown into hot water, and fed to swine. An entomological friend has found by his own experience, that roasted grasshoppers are excellent eating,— "better than frogs." Only let some enterprising genius of the kitchen once set the example of offering to his customers roasted grasshoppers, rare done, and fricasseed canker-worms,—for we have it on the word of an entomologist that caterpillars are pleasing to the palate of man,—and these droves of entomological beeves will supplant their vertebrate rivals at the shambles, and instead of cattle-fairs, we shall have Grasshopper Festivals, and County Caterpillar Shows.

GEOLOGY.

The Two Earliest Known Races of Men in Europe.—Recent discoveries in archæology, now generally accepted among scientific men, tend to show that man has lived many ages before History gives a hint, either by tradition or written record, of his existence. There are races of fossil men, which have peopled certain areas, and then passed away, their places to be filled by new and strange peoples. Thus the study of prehistoric man belongs with the study of fossil animals and plants, or Palæontology. The life of man upon the earth can only be measured *relatively* in the geological scale, not by recorded

years. Thus Palæontology fades into Archæology, or the study of ancient or prehistoric man; and Archæology graduates into History, which comprises the oral or written accounts of man.

Though the subject is still in a crude state, the conclusions here presented result from the careful observation of facts, now generally received by the soundest geologists and archæologists of the day. The majority of ethnologists agree that man had a common origin, and that his birth-place was in the eastern portion of the old world, whence he has migrated westward. In Europe, where the remains of prehistoric man have been most carefully studied, they have been considered to characterize three periods, or ages, namely: first, the *Stone age*, when stone alone, not metals, was used in the construction of implements; second, the *Bronze age*, characterized by a higher style of art, and the use of implements made for the most part of bronze; and third, the *Iron age*, when such implements of the chase, of war, and domestic life, were constructed largely of iron. Each period is a step towards a higher civilization. From being a simple savage, living singly or in small tribes, without organization, and scarcely able to hold his own against the gigantic wild beasts of those times, we trace, by means of the relics of a slowly forming art, the successive steps of man's intellectual and physical elevation. In all his relations our ideal man, representing the human species as a whole, shows a constant progress upwards.

Races of gigantic mammals, such as the Megatherium, Mammoth, and Mastodon, two species of Rhinoceros, the Cave Bear, Lion, Irish Elk, a large species of Beaver, and the Aurochs, have passed away before his attacks. The rudiments of the art of sculpturing and printing appear at a distinct period, the domestic animals are introduced, the cereals and implements for converting them into food appear, something like national unity binds together hordes of savage men, when History lifts the veil. During this long period of more than Cimmerian darkness, the surface of the earth had undergone great changes. It was probably just emerging from the Glacial Period, when the climate of northern Europe and America was much like that of Greenland at the present day, though the extremes of the climate could not have been so great, it seems to us, as generally stated by European writers. All our rivers ran in much deeper channels, while broad estuaries and chains of lakes covered what are now fertile plains and intervals, dotted with towns and villages. It is safe to say, that man lived as long ago as the Terrace or Lake Period of geologists, on which the Glacial Epoch overlapped.

In an interesting article in the London "Quarterly Journal of Science," by W. B. Hawkins, "On the Habits and Condition of the Two

Earliest Races of Men," the author gives an account of the two races, which succeeded one another during the first, or Stone Period. He states that—

"The gravel-beds of France and England, and the bone caverns of these two countries and of Belgium, have afforded the earliest known traces of man upon the earth. The original discoveries of M. Boucher de Perthes, at Amiens and Abbeville, followed up by the cautious energy of Mr. Prestwich, F. R. S., prove that man coexisted with the fossil mammoth and woolly rhinoceros on the banks of the Somme, at a time when it flowed at a much higher level than at present, and when the relations of hill and valley were altogether different in that district. The labors of the latter, and of Mr. Evans, F. R. S., have resulted in the proof that the same race of men lived in Britain, from Suffolk on the east, as far south as the coast of Hampshire. My own discoveries in Wookey Hole, Hyænaden, extend their range into Somerset; those of Mr. MacEnery, in Brixham, into Devonshire; and, lastly, those of Dr. Falconer, in Pembrokeshire, into South Wales. Throughout the whole of this area, the same types of flint implements and weapons prevail. A splinter of flint afforded the only cutting edge they possessed; a mass of flint, rudely chipped into a point, was their only boring tool; large, thick, rudely-fashioned 'spear-heads' their principal weapon. The so-called 'sling-stones,' either intended for use as missiles, or imbedded in gum, or bound round with withes, as axes, and some pointed masses of flint which may have been used for digging, comprise the list of their remains from the gravel-beds. . . . The calcined bones on the floor prove that the use of fire was not unknown, and that the cave was inhabited. The evidence afforded by this scant list of the implements and weapons proves that the race of men who used them were savages of the very lowest order, unacquainted with the art of spinning or of making pottery, and living on the fruits of the chase without the aid of the dog. . . . Thus scant is our knowledge of the earliest known men, the Flint Folk par excellence, a race that is as truly fossil and extinct as the Mammoth and Woolly Rhinoceros with whom they lived. To M. Lartet, and the late M. Christy, we owe the proof of the existence of a second race of men in the south of France, in the Department of Dordogne, in the valleys through which flow the Vezere, the Dordogne, and their tributaries. They dwelt in caves and under sheltering rocks, and accumulated around their dwellings the remains of the animals they eat, and vast quantities of the implements and weapons they used. In all the caves and rock-shelters except one, the remains of the Reindeer were most abundant, and evidently constituted the chief food of these savages of the Dordogne, who may therefore be conveniently termed Reindeer Folk, in contradistinction to the Flint Folk described above. The presence of the Mammoth and Cave-lion (the remains of which were few) in the refuse heaps, proves that the age of the Reindeer Folk was that of the great extinct Pachydermata, while the occurrence of the Musk-sheep and Reindeer, animals confined to the cold regions of the north, indicates the arctic nature of the climate at that time in France. The implements are of a higher order, and denote a higher degree of civilization than those of the Flint Folk. . . . The most remarkable remains, however, by far are figures of animals engraved upon stone, antler, bone, or ivory, the earliest traces of sculpture known in western Europe. A slab of schist from Les Eyzies bears the outline of a deer; the lines, however, are too confused for specific identification. The rock-shelter of Laugerie-basse has furnished an outline of the hind quarters of a large ox, boldly and skilfully engraved on the palmated antler of a reindeer. On a second fragment of reindeer antler, the ancient artist has depicted the figure of a horned ruminant, probably the Bouquetin, of which the remains were abundant, and as he had no room to draw the hind legs in their natural position, he doubled them forwards, until the hoofs touched the animal's belly, and thus completed the whole beast. Other fragments of antler, from the same locality, were fashioned into ornamental spoons, or marrow-scoops; and, in one case, a reindeer, kneeling on his forelegs, with eyes, ears, antlers, and tail most distinctly cut, formed the handle of an implement of some kind.

From the rock-shelter of La Madelaine has been obtained most remarkable and unlooked-for evidence of the co-existence of man with the mammoth, in a fragment of fossil ivory, bearing upon it the well-defined figure of the extinct species of Elephant to which it

belonged.* The artist has given to it, not only the tusks with eccentric curvature which are so common in the drift-gravels, but also has marked, in a most unmistakable way, the long hairy mane which we know, from the discovery of the frozen mammoth carcass in the north of Russia, characterized that extinct animal. This specimen, therefore, is most important, not only as an example of the early dawn of art, but also because it stamps the age of the artist to have been that of the Mammoth."

Mr. Dawkins states that the Reindeer Folk seem to have differed from the Flint Folk, "because, although both lived very much under the same physical conditions, in no case are their implements or weapons found together." The implements of the Reindeer Folk indicate a more civilized as well as more modern people, and the small handles of their implements, the similarity of the bone needles, of the marrow-spoons, the habit of carving figures of various animals on bone, etc., and of splitting the bones for the sake of the marrow, and the occurrence of human remains in the refuse heaps of the Reindeer Folk, have caused this fossil race to be compared to the present Esquimaux. It is indeed, as Mr. Dawkins states, not improbable that the Esquimaux, or allied races, formerly ranged as far south as the Alps or Pyrenees.

The differences between these two races are also borne out by other palæontological evidence. With those of the Flint Folk occur remains of the "Sabre-toothed Lion (or Tiger), the Elephas Antiquus, the Hippopotamus, and the Woolly and Leptorine Rhinoceros," which with the exception of the two last, "began to live in the remote epoch called the Pliocene." In the refuse heaps of the Reindeer Folk, however, only two extinct species of mammalia are found, the Irish Elk, and the Mammoth, "both of which sprang into being in the Pleistocene [or Quaternary] period."

"The three animals that especially characterize the Reindeer deposits of Dordogne, as compared with those of the Flint Folk age, are the Antelope Saiga, the Ibex, and the Chamois; of these, the former ranges now through the great central plateau of Asia, the second lives in the Pyrenees, and the last in the Alps."

After these two races had passed away, their soil was occupied in western Europe by a people whom Sir John Lubbock terms Neolithic (*neos*, young; *lithos*, stone). This race invented the use of pottery, and the art of spinning.

"They dwelt in huts, the bottoms of which are now known under the name of hut circles, which are sunk in the earth, or raised on piles driven into the shallows of lakes, as in Switzerland. The tumuli spreading over France, Germany, Britain, and Scandinavia, prove their belief in a future state, as well as their reverence for the dead, whom they buried without burning."

Their implements were elaborated with more skill; they had domesticated the dog, and in the Pile-works of Switzerland are found "the

* Annales des Sciences Naturelles. 5e. ser. t. iv., 6 cahier.

earliest known assemblage of *domestic* animals, the horse, pig, goat, sheep, and ox," and the cakes and seeds found in their dwellings prove that they were acquainted with agriculture. Nearly contemporaneous, or perhaps earlier, lived a similar race in Scandinavia, in whose refuse heaps occur the bones of the Great Auk (*Alca impennis*), which, during this century, has become extinct in Europe and North America, and the Oyster, which they largely fed on, has also disappeared from the Baltic Sea. "The habits of this race were probably similar to the savages of Tierra del Fuego at the present day."

The "Bronze-using Folk arrived in Europe before the dawn of History, and lived there up to the time when history begins. . . . They were acquainted with the use of the potter's wheel, and were in the habit of burning their dead." They used the horse, and had flocks and herds.

The Iron Age came in before the Romans invaded Northern Europe, as they met the Gauls riding in chariots, armed with iron weapons, on the battle-field.

How far these distinctions apply to other countries than Europe, even in the old world, and how far they agree with the very incomplete history of our Aboriginal refuse-heaps, mounds, and relics of American prehistoric races, remains yet to be shown.

MICROSCOPY.

THE VOLVOX AND ITS PARASITE.—In examining with the microscope some specimens of "Volvox globator," one was found containing one of the Rotifera, a female of *Notommata Parasitica* (mentioned by Pritchard as sometimes found in such a situation). When first seen it was feeding, picking out the green masses composing the Volvox, and swallowing them, occasionally shifting its position and selecting a fresh spot. Two eggs had been deposited, and another could be seen in the ovary; they were of a reddish tint, and filled with granules. There was no sign yet of organized structure.

Twenty-four hours after, the Rotifer was dead, but the young could now be plainly seen moving in the eggs, and cilia were in rapid vibration at two distinct points. While still under examination, one of the young broke through the envelope surrounding him, and, after a few energetic struggles, was free and swimming rapidly about the interior of his prison, but did not appear to make any attempt to leave it. The egg-shell or membrane left behind was very delicate and transparent, without dots or markings, the aperture broken off by the animal being plainly visible. The other egg would have soon hatched, as the animal was in active motion within it, but unfortunately the water leaking out

of the live-box containing it, put an end to the observation. The Volvox did not seem disturbed by its strange occupant, but continued its stately revolutions as though they were not present. — B. Webb, Jr.

NATURAL HISTORY CALENDAR.

The Insects of July. — During mid-summer the bees and wasps are very busy building their nests and rearing their young. The Humble-bees, late in June and the first of this month, send out their first broods of workers, and about the middle of the month the second lot of eggs are laid, which produce the smaller-sized females and males, while those eggs laid late in the month and early in August, produce the larger-sized queens, which soon hatch. These hybernate. The habits of their peculiar parasite, *Apathus*, an insect which closely resembles the Humble-bee, are still unknown.

The Leaf-cutter Bee (*Megachile*) may be seen flying about with pieces of rose-leaf, with which she builds, for a period of twenty days, her cells, often thirty in number, using for this purpose, according to Mr. F. W. Putnam's estimate,* at least one thousand pieces! The bees referred to "worked so diligently that they ruined five or six rose-bushes, not leaving a single unblighted leaf uncut, and were then forced to take the leaves of a locust tree as a substitute."

The Paper-making Wasps, of which *Vespa maculata* (Fig. 1), the "White-faced Wasp" is our largest species, are now completing their nests, and feeding their young with flies. The Solitary Wasp (*Odynerus albophaleratus*) fills its earthen cells with minute caterpillars, which it paralyzes with its poisonous sting. A group of mud-cells, each stored with food for the single larva within, we once found concealed in a deserted nest of the American Tent Caterpillar. Numerous species of Wood Wasps (*Crabronidæ*) are engaged in tunnelling the stems of the blackberry, the elder, and syringa, and enlarging and refitting old nail-holes, and burrowing in rotten wood, storing their cells with flies, caterpillars, aphides, and spiders, according to the habit

Fig. 1.

* See Proceedings of the Essex Institute, vol. iv. p. 105.

of each species. *Eumenes fraterna*, which attaches its single, large, thin-walled cell of mud to the stems of plants, is, according to Dr. T. W. Harris, known to store it with canker-worms. *Pelopæus*, the mud-dauber, is now building its earthen cells, plastering them on old rafters and stone-walls.

The Saw-flies (*Tenthredo*), etc., abound in our gardens this month. The *Selandria vitis* attacks the vine, while *Selandria rosæ*, the Rose-slug, injures the rose. The disgusting Pear Slug-worm (*S. cerasi*), often live twenty to thirty on a leaf, eating the parenchyma, or softer tissues, leaving the blighted leaf. The leaves should be sprinkled with a mixture of whale-oil soap and water, in the proportion of two pounds of soap to fifteen gallons of water.

Among the Butterflies, *Melitæa Ismeria*, in the south, and *M. Harrisii*, in the north, is sometimes seen. A second brood of *Colias Philodice*, the common sulphur-yellow butterfly appears, and *Pieris oleracea* visits turnip-patches. It lays its eggs in June on the leaves, and the full-grown, dark green, hairy larva may be found in August. The last of the month a new brood of *Grapta comma* appears, and a second brood of the larva of *Chrysophanus Americanus* may be found on the sorrel.

The larvæ of *Pyrrarctia isabella* hatch out the first week in July, and the snuff-colored moth enters our windows at night, in company with a host of night-flying moths. These large moths, many of which are injurious to crops, are commonly thought to feed on clothes and carpets. The true carpet and clothes moths are minute species, which flutter noiselessly about our apartments. Their narrow, feathery wings are edged with long silken fringes, and almost the slightest touch kills them.

Fig. 2.

Fig. 3.

Among Beetles, the various borers, such as the *Saperda*, or apple-tree borer, are now pairing, and fly in the hot sun about trees. Nearly each tree has its peculiar enemy, which drives its galleries into the trunk and branches of the tree. Among the Tiger Beetles frequenting sandy places, the large *Cicindela generosa* (Fig. 2), and the *Cicindela hirticollis* are most common. The grotesque larvæ live in deep holes in sand-banks.

Fig. 4.

The nine-spotted Lady Bug, *Coccinella novemnotata* (Fig. 3, with pupa) is one of a large group of beetles, most beneficial from their habit of

feeding on the plant-lice. We figure* another enemy of the Aphides, *Chrysopa*, and its eggs (Fig. 4), mounted each on a long silken stalk, thus placed above the reach of harm.

Fig. 5.

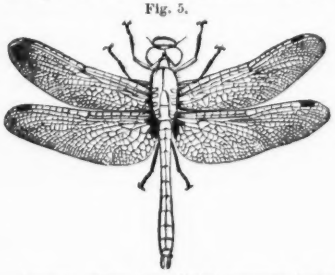
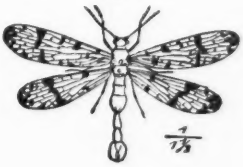


Fig. 6.



Among other beneficial insects belonging to the Neuroptera, is the immense family of *Libellulidæ*, or Dragon-flies, of which *Diplax Berenice* Drury (Fig. 5), is a fine representative. The Forceps-tail, or Panorpa, *P. rufescens* (Fig. 6), is found in bushy fields and shrubbery. They prey on smaller insects, and the males are armed at the extremity of the body with an enormous forceps-like apparatus. — A. S. P.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Academy of Natural Sciences of Philadelphia. *March* 19, 1867. Prof. E. D. Cope presented to the Academy a young specimen of the Whale, known as the Bahia Finner, procured near Bahia, Brazil; the length was twenty-one feet. It was shown to belong to the genus *Megaptera* Gray, the Hump-back Whales of sailors.

Dr. Leidy exhibited a number of plates of a forthcoming work on the extinct mammals of Nebraska and Dacota, among which was one representing an almost complete skull of an animal, which he characterized under the name of *Agriochærus latifrons*.

Prof. Ennis inquired whether remains of the Hippopotamus had been found in this country. Dr. Leidy replied that no evidence existed of the animal, though Mr. J. A. Conrad had at one time a tooth which he considered to have belonged to the Hippopotamus.

April 2. — Mr. Thomas Meehan presented a paper "On Dicœcious Forms of Vitis vinifera L." Prof. Ennis remarked upon "the differ-

* The cuts used in this article were kindly allowed to be taken from a Report on the Beneficial Insects of Massachusetts, by Mr. F. G. Sanborn, in the Massachusetts Agricultural Report for 1862.

ent ranges of temperature in the Provinces adjacent to the United States." He also spoke upon "The rise and fall of the floor of the Pacific Ocean, and the resulting geological phenomena."

Boston Society of Natural History. *March* 6, 1867.— Dr. J. C. White exhibited a specimen of Guaranà, moulded into the form of the Jararàca, the most poisonous of Brazilian serpents; it was brought from Brazil by Mrs. Agassiz, and was presented to the Society by Dr. Cotting. The Guaranà is made from the seeds of the *Paullinia sorbilis*, which are roasted, ground, mixed with water, moulded, and dried hard in an oven. It contains a larger quantity of caffine than either tea or coffee, and resembles in appearance common chocolate; dissolved in water it is used as a refreshing drink, and as a remedy for fevers and other ailments. The Manès Indians, who manufacture it, believe it to be more efficacious when made into the form of a serpent, as in the specimen exhibited.

Dr. T. M. Brewer remarked upon the Wood-warblers of North America, a group of birds which unite in a remarkable degree the habits of the tree-creepers with those of the fly-catchers. In some species these habits are alternated as occasion seems to prompt. Some are almost entirely creepers, others almost exclusively fly-catchers. The yellow red-poll warbler is the only one of this group which is known to breed upon the ground, or to be at all terrestrial in habit, by choice; when occasion offers it can be an expert fly-catcher, but when seeking its food on the ground its motion is graceful and easy, showing that the habit is native to the bird, and not assumed by the prompting of necessity.

Entomological Society of Canada. *Toronto, March* 1, 1867.— The Secretary announced that Mr. Saunders, the Curator of the London Branch, was having published for the Society a list of Canadian Coleoptera, which would include about eight hundred species. The meeting then proceeded to the examination and discussion of Canadian *Sphingidæ*, the subject appointed for the evening. The capture, in 1866, of *Philampelus satellitia* Linn., for the first time in Canada, was announced. Dr. Sangster exhibited a number of rare and beautiful specimens, and the Rev. C. J. S. Bethune an undetermined Sphinx captured at Grimsby, C. W. Prof. Hincks made some remarks upon the classification of the *Sphingidæ*, and insects in general, on a "quinary system."

It was resolved, that from May to August, Field Meetings be held on each *second* and *last* Saturday of the month.